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ABSTRACT

A detailed analysis of the significant gender differences observed in performance on the mathematics portion of the Scholastic Aptitude Test (SAT) in 1986 was performed for students enrolled in the Montgomery County Public Schools (Maryland). A disaggregation of data from the 1986 SAT administration was performed to examine homogeneous subgroups and shed light on two of the factors believed to affect differential performance: (1) courses taken; and (2) socioeconomic status. SAT data are presented for the county's 2,924 female and 2,715 male SAT-takers (in grade 12) who graduated in 1987. Data assessed included information on participation and performance of females in grades 1 through 12; SAT scores of men and women in different ethnic groups; and SAT scores of white women and white men of comparable educational background. A thorough analysis of the data available on course participation, school performance, socioeconomic status, student and parental attitudes toward mathematics, and possible school effects suggests that the reasons for the persistence of the gender gap in mathematics test performance lie outside these factors. The study did not contribute to the current effort to examine test bias as a source of the persistent differential performance on the SAT math test by male and female students. Seven data tables are provided. (TJH)

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THE SAT-M GENDER GAP: LOOKING AT MICRO LEVEL DATA

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Paper presented at the Annual Meeting of the American Educational Research Association, San Francisco, March 1989.

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THE SAT GENDER GAP: LOOKING AT MICRO LEVEL DATA

INTRODUCTION

In recent years, efforts by educators and policy makers have been primarily focussed on improving participation and performance in mathematics and science by minority students of both sexes. However, gender differences on standardized aptitude tests and especially the poorer performance of women compared to men on the math portion of the SAT continue to be a source of concern in the education community.

In defining the focus and objectives of the study it carried out in 1986 under a grant from the National Science Foundation, the Montgomery County school system gave equal attention to gender and ethnic factors in setting the overall goals of the study:

> ...to identify at what points in the educational process differences appear in mathematics participation and performance
>
> ...to identify the factors in the school, home, and society that contribute to differential participation

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...to suggest alternatives for schools to increase the enrolment and achievement of females, Blacks, and Hispanics in mathematics.

The topic of this paper is the detailed analysis of the gender differences observed in Montgomery County in 1986 on the math portion of the SAT. The reason we have selected this topic again for presentation this year (after reporting some preliminary data at the 1988 AERA meeting) is that it is primarily with respect to SAT results that noteworthy gender differences exist in the mathematics performance among the current generation of Montgomery County students. We will present these findings in the first section of this paper. It may well be that there are other school systems where differences exist at the elementary and secondary level, and we would not claim that we can generalize from the findings for our county. But in Montgomery county, where there is a tradition of high proportions of college oriented students, but also a recent increase in the number of students from lower income backgrounds, we found that women and men were surprisingly similar with respect to course participation and scores obtained on tests other than the SAT.

Much of the current discussion about gender differences in SAT

scores centers on high school courses taken, socio-economic and ethnic differences in student performance, and item bias in the test.(College Board News, 1987; Clark and Grandy, 1984; Doolittle, 1984; Lowen, Rosser and Katzman, 1988). Since we presented preliminary data last year, we have further disaggregated the 1986 data in an effort to examine homogeneous subgroups and thus shed light on two of the factors believed to affect differential performance: course taking and socio-economic status. Examining differences in SAT scores by gender, ethnicity and participation in the curriculum at the county and individual high school level offers the advantage of controlling to some extent for variables introduced by the school context. Although the role of individual teachers and counselors should not be minimized, and participation in special programs to enhance study and test taking skills no doubt play a part as well, the existence of a common curriculum and uniform administrative practices provide a good setting within which to look at the scores of students of comparable social and ethnic status and comparable participation in the math curriculum.

PARTICIPATION AND PERFORMANCE OF WOMEN IN GRADES 1 - 12.

Data from the NSF sponsored study show that participation and performance in the mathematics curriculum is fairly equal for male and female students from kindergarten through the first years of high school. For example, the percentage of students

working at, above or below grade level was identical for male and female students in grades 1 through 7. At the high school level, where we had anticipated that important differences would emerge, with women less likely to enroll in advanced classes once the graduation and college admissions requirements had been satisfied, we found the differences to be very small: 27% of the men as against 23% of the women had taken the most advanced courses. (Table 1)

Mathematics achievement was measured in the elementary and junior high/middle school grades by scores on the California Achievement Test (CAT) and on locally developed and calibrated criterion-referenced tests (CRT's). At the high school level, the CAT was administered in the 11th grade and the SAT in the 11th and 12th grades. By far the largest gender differences were found on the SAT; these will be discussed below. On all other tests, overall performance was very similar although there were fairly consistent differences on sub-sections of the CAT with girls doing better than boys on computations and less well on concepts. Small differences were also noted in the proportions attaining the highest stanine category, as shown in Table 2.

In our earlier paper (Sharp, 1988) we discussed at length attitudinal and behavioral variables which might explain gender differences in SAT-M scores. With respect to student attitudes and the behavior and attitudes of parents and teachers, we found

fewer gender differences than we had anticipated, indicating that the old stereotypes about women and mathematics may be on the decline. The major gender difference which continues to persist is in the area of occupational aspirations: the proportion of women interested in math and science-based careers is still much smaller than among comparably educated men. But primarily, we found that factors such as math anxiety, liking of math, problem solving styles and occupational and educational aspirations are so closely related to participation in the math curriculum that their separate effects on SAT-M performance could not be isolated. For this reason, we did not include further discussion of these data in this paper.

SAT SCORES OF MEN AND WOMEN IN DIFFERENT ETHNIC GROUPS

The SAT data presented below are for the county's 5639 SAT-takers who graduated in 1987. Table 3 shows that the proportion of students who took the test was highest among Asians, followed by whites and Blacks, with Hispanics in last place. In all ethnic groups, slightly higher proportions of women than men took the test, and for the county as a whole, the proportion of SAT takers among 12th grade women has risen from 69% in 1982 to 76% in 1987. (Comparable figures for males indicate that the proportion rose from 65% in 1982 to 73% in 1987.) Table 4 summarizes test scores by sex and ethnicity and male/female differences. Gender differences are greatest for Whites and Hispanics, smallest for

Blacks and Asians; in both of these latter groups, women outperformed men on the verbal portion of the test and while men did better than women on the math portion, the difference in scores was much smaller than for Whites and Hispanics. Off-hand, there is no evidence from these data that in Montgomery County, the persistence of lower female scores is attributable to the larger proportion of minority students or to a dramatic increase in the proportion of female test takers;if anything, the net effect of changes in the ethnic composition of SAT takers should have narrowed the gap, especially in the verbal portion.

We looked for clues in our data to see if the smaller sex differences for minorities in Montgomery county might be the result of relatively large proportions of minority test-takers from middle to high income families, since parental education (and thus income) have shown some correlation with SAT scores. (Clark & Grady). We could not do this with a high degree of accuracy since we do not have data for individual students' socio-economic status, but only have broad income indicators for black and white families in each high school's feeder area. These are based on 1980 Census information. Furthermore, lower proportions of Black students take the SAT than is the case for Whites and Asians, and there are few high schools in the county which serve predominantly either black or white low-income families. In a few high schools, we have sufficient numbers of

Black or Asian students to make some gender comparisons; these are shown in Table 5. Regardless of income, male/female score differences were lower for Blacks than for Whites; the findings for Asian students are less consistent.

SAT-M SCORES OF WHITE WOMEN AND WHITE MEN OF COMPARABLE EDUCATIONAL BACKGROUND

According to the College Board and the various testing organizations, the major reason for differential performance on college aptitude tests in the mathematics domain is women's lower participation in advanced math courses. Although the test itself does not require advanced math knowledge, it is generally accepted and has been shown in a number of studies including ours that students who had taken the most advanced classes obtained the highest scores, whether as the result of higher math aptitude or greater experience and facility in dealing with math concepts and problems.It has also been demonstrated that among comparably prepared students, the gender gap persisted, although it was lowest among the most advanced students (Lee). Our own investigations resulted in similar findings, with a lower gender gap among calculus takers than among the next two groups (those who had gone as far elementary functions or analytic geometry, and those who taken an accelerated algebra/trigonometry course.)

but a smaller gap in all groups of less advanced math takers (Table 6) These non-linear results led us to believe that they might be attributable to ethnicity and socio-economic status.

For this reason, we further examined these data at the micro level to see if perfect matching of males and females would produce smaller differences. We attempted to create homogenous populations by examining comparably prepared white students in each of four high schools situated in neighborhoods with families in various income ranges in 1980. Gender differences in SAT-M scores are presented in Table 6. These data do not show a narrowing of the gender gap when controls for course-taking, ethnicity, school environment, and a proxy income measure are introduced. Obviously, we are dealing with small numbers and an imperfect SES indicator, but on balance we are not persuaded by the examination of school by school data that either course participation or the socio-economic status of students can explain the stubborn persistence of the gender gap when we look at micro-level data.

CONCLUSION

A thorough analysis of the data available on course participation and school performance, socio-economic status,student and parental attitudes toward mathematics, and possible school effects suggests that the reasons for the persistence of the gender gap in mathematics test performance lie elsewhere. We have

not been able to contribute through our research to the current effort to examine test bias as a source of this persistence; recent research by Rosser and others suggests that this is indeed a fruitful area for further research. The differences which we observed in earlier tests, where women and men differed with respect to certain types of math skills, but ended up with comparable classroom performance, curriculum participation, and test scores, also lend support to the need for further research on cognition and behavior, with emphasis on problem solving styles, which may suggest the need for some test re-design to achieve sex equity.

But sex equity is not the only reason why it is important that tests measure accurately the ability level of all students. Given the importance attached to test scores by the students themselves, it may not be farfetched to hypothesize that women's awareness that they score lower than their male peers may play a role in career decisions. Women may conclude from the score differences that they are not as good as their male peers (or perhaps are less competent test takers) and should therefore not try to compete in these fields at the graduate and professionel levels. I believe one of the most important reasons for working toward a math test which will fairly measure the aptitude of women as well as men is that it would not only correct inequities, but would increase women's participation in fields where they are now under represented and where they are sorely needed.

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TABLE 1

Highest Course Taken by Students in the Class of 1986: Overall and by Gender

Highest Mathematics Course Taken	Overall		Females		Males	
	N	%	N	%	N	%
Calculus	874	14	409	12	465	15
Elementary Functions and Analytic Geometry	725	11	368	11	357	12
Advanced Algebra	1,145	18	638	19	507	17
Algebra 2 with Trigonometry (accelerated)	186	3	98	3	88	3
Trigonometry	252	4	124	4	128	4
Algebra 2	962	15	546	16	416	14
Geometry	766	12	388	12	378	12
Algebra 1	566	9	324	10	242	8
Algebra 1, Part 1 (first year of slow-paced course)	62	1	25	1	37	1
General Mathematics *	871	14	433	13	438	14
Number of Students	6,409		3,353		3,056	

* Consists of Math 9, Business Mathematics, Applications of Mathematics, Consumer Mathematics, and Related Mathematics.

Table 2 CAT Scores[a] and Percent of Students Who Attained the Highest (9th) Stanine

	Females	Males
3rd Grade		
N Tested	2595	2552
Percent in 9th Stanine	24	30
Score on CAT - Math Computations	70	71
Score on CAT - Math Concepts	66	68
5th Grade		
N Tested	2607	2582
Percent in 9th Stanine	29	30
Score on CAT Math Computations	70	68
Score on CAT Math Concepts	71	72
7th Grade		
N Tested	2432	2391
Percent in 9th Stanine	10	11
Score on CAT Math Computations	66	64
Score on CAT Math Concepts	66	68
11th Grade		
N Tested	3622	3347
Percent in 9th Stanine	17	21
Score on CAT Math Computations	64	62
Score on CAT Math Concepts	65	67

[a] Scores are Average Normal Curved Equivalents (NEC) Scores

Source: Montgomery County Public Schools; tests taken during 1984-85 school year

TABLE 3

12th Grade Enrollment and Number and Percent of SAT Takers, by Sex and Ethnicity, 1986

	Number enrolled	Number tested	% tested
All students*			
Female	3960	2924	74
Male	3851	2715	71
White Students			
Female	2975	2274	76
Male	2824	2095	74
Black Students			
Female	523	299	57
Male	448	229	51
Asian Students			
Female	306	263	86
Male	377	294	78
Hispanic Students			
Female	150	84	56
Male	192	94	49

* Includes 7 students in other ethnic groups.

Table 4 1987 SAT Scores by Sex and Ethnicity

	SAT-V	SAT-M	(N)
Total County			
Males	470	541	2715
Females	467	499	2924
M/F Difference[a]	+3	+42	
White			
Males	489	554	2095
Females	481	509	2274
M/F Difference	+8	+45	
Black			
Males	383	418	229
Females	395	412	299
M/F Difference	-12	+6	
Asian			
Males	414	558	294
Females	450	544	263
M/F Difference	-36	+14	
Hispanic			
Males	421	477	94
Females	402	430	84
M/F Difference	+19	+47	

[a] + Male Higher; - Male Lower

Table 5 1987 SAT Scores by Sex and Ethnicity
in 4 High Schools

	# of Students	Family Income[1]	SAT - V M	SAT - V F	SAT - V Diff.[2]	SAT - M M	SAT - M F	SAT - M Diff.
A								
Whites	257	55,000	527	527	0	575	527	+48
Blacks	43	25,000	370	397	-27	433	427	+6
B								
Whites	169	44,000	482	486	-4	566	501	+65
Blacks	71	39,000	352	386	-14	403	410	-7
Asians	44	N/A	463	359	+104	574	482	+92
C								
Whites	445	70,000	501	496	+5	566	535	+31
Asians	44	N/A	472	556	-84	607	644	-37
D								
Whites	242	50,000	495	491	+4	582	507	+75
Blacks	70	43,000	386	381	+5	410	388	+22
Asians	54	N/A	431	452	-21	535	523	+12

[1] Estimated from 1980 Census data

[2] + Male Higher; - Female Higher

TABLE 6

Highest SAT Mathematics Score Obtained in Junior or Senior Year, by Gender and Highest Math Course Taken in High School

Course	No. of Students	Average Score		Male/Female Difference
		Female	Male	
Calculus	761	659	696	+ 37
Elem. Funct. & Anal. Geometry	590	588	635	+ 47
Alg. 2 & Trig. (accelerated)	144	575	627	+ 52
Advanced Algebra	916	511	552	+ 41
Trigonometry	185	494	533	+ 39
Algebra 2	640	447	480	+ 33
Geometry	391	391	433	+ 42

TABLE 7

SAT-M Scores of White Men and Women Matched by School and Highest Math Course Taken (1986 Seniors)

School	White Family Income (1980)	Highest Course Taken: Calculus	Functions	Advanced Alg.	Alg. 2	Geometry
A	55,000					
Men		723(14)	634(11)	581(24)	*	*
Women		661(19)	608(11)	519(47)	*	*
M/W diff.[b]		+62	+26	+62		
C	70,000					
Men		715(44)	647(39)	556(38)	509(22)	488(18)
Women		670(48)	614(22)	534(57)	464(33)	436(16)
M/W diff.		+45	+33	+22	+45	+52
L	36,000					
Men		670(22)	619(21)	565(19)	482(13)	414(15)
Women		652(25)	573(12)	500(23)	460(29)	409(20)
M/W diff.		+18	+46	+65	+22	+5
D	50,000					
Men		740(19)	645(25)	534(12)	457(16)	*
Women		699(10)	592(27)	505(37)	443(20)	
M/W diff.		+41	+53	+29	+14	

Note: High schools in this table are those where at least 10 male and female SAT takers were found at 3 or more course taking levels.

* fewer than 10 test takers

a numbers in parentheses show the N of test takers

b + indicates male higher - indicates female higher

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